



# Transportation Synthesis Report

Nina McLawhorn  
Research Administrator  
Wisconsin Department of Transportation  
608-266-3199

Request a TSR: [nina.mclawhorn@dot.state.wi.us](mailto:nina.mclawhorn@dot.state.wi.us)  
[pat.casey@ctcandassociates.com](mailto:pat.casey@ctcandassociates.com)

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## Overlay of Shoulder Rumble Strips

*Prepared for*  
**Bureau of Technical Services**

*Prepared by*  
**CTC & Associates LLC**  
**WisDOT Research & Communication Services**  
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*Transportation Synthesis Reports are brief summaries of currently available information on topics of interest to WisDOT technical staff. Online and print sources for TSRs include NCHRP and other TRB programs, AASHTO, the research and practices of other transportation agencies, and related academic and industry research. Internet hyperlinks in TSRs are active at the time of publication, but changes on the host server can make them obsolete.*

### **Request for Report**

The Bureau of Technical Services requested a quick look at the state of the practice in HMA overlay preparation of shoulders that feature rumble strips. The type of surface to be overlaid, and the methods of rumble strip application – that is, milling or rolling – were to be identified when possible. Finished research and statements of practice were specifically requested.

### **Summary**

In a search of national and select state transportation and research Web sites, we found that WisDOT's foresight in seeking information on treatment of shoulder rumble strips prior to overlay puts it at the forefront of interest in the topic. A study from the New Hampshire Department of Transportation that remains in progress appears to be the only study of overlays of shoulders with rumble strips. Rumble strips clearly have yet to reach a maturity by which their overlay will have been in practice long enough for standard best treatments to emerge.

The project manager for the New Hampshire study, Denis Boisvert, freely provides information on NHDOT findings to date. The basis of the study was overlays in which reflection cracks from old rumble strips were observed in 2003. In response to the cracking observed, Mr. Boisvert contacted other state transportation agencies to determine what other agencies were doing with such overlays. It seems that some states do little to prepare surfaces, while others may mill the surface, use leveling materials, or simply rely on multiple lifts or depths ranging from two to four inches in overlays.

Below we offer details from experience with these overlays in **New Hampshire**, as well as a digest of the responses on **State Practices** that Mr. Boisvert received from state agencies that have experience with overlaying shoulders with rumble strips. We also highlight three **Study Documents** from NHDOT, including the approaches used on four field sites and the results of two annual inspections since the installation. Finally, we cite mention by FHWA of the **Massachusetts** practice with overlays of shoulders with rumble strips.

### **New Hampshire**

Currently NHDOT hasn't an official policy on paving over rumble strips, but standard practice has been to use a one-inch HMA overlay. In 2003 two asphalt shoulder overlays of the Everett Turnpike in Nashua showed cracking upon inspection, both suggesting reflection cracking from the original rumble strips. This motivated a four-year study that included preliminary inquiries of other state transportation agencies for practices. In this study NHDOT constructed four overlays employing 1.5-inch overlays and different preparation methods, finishing each 500-foot section in the summer of 2005. New strips and milling will take place sometime in 2006. Denis Boisvert, the NHDOT research project manager, provided us with inspection reports from the study sites and with e-mails of interest.

**State Practices.** Inquiry responses in April of 2003 showed practices ranging from no preparation of surfaces in cases with half-inch deep strips and overlays of over four inches, to grinding and shimming. The following states reported experience with overlays of shoulder rumble strips.

- Georgia mills strips if deteriorated; otherwise, the department cleans shoulders with power brooms, then applies a fine leveling mix (dense graded, 4.75 mm or 9.5 mm) before overlay. In each case a tack coat is also sprayed to prevent delamination (Peter Wu, State Bituminous Construction Engineer, [Peter.Wu@dot.state.ga.us](mailto:Peter.Wu@dot.state.ga.us)).
- Maine applies a leveling course, either by extending the leveling of the mainline over the strips, or by leveling the shoulders entirely (Bruce Yeaton, Testing Engineer, Materials Testing and Exploration, [bruce.yeaton@maine.gov](mailto:bruce.yeaton@maine.gov)).
- Maryland reports no problems with overlays of unprepared rumble strips, though overlays used are two inches or more, and may include multiple layers (Peter Stephanos, Director of Materials and Technology, [pstephanos@sha.state.md.us](mailto:pstephanos@sha.state.md.us)).
- Nebraska does no surface preparation and uses two-inch or thicker layers (Moe Jamshidi, Nebraska M&R Engineer, [mjamshid@dot.state.ne.us](mailto:mjamshid@dot.state.ne.us)).
- New Jersey mills out rumble strips before paving (Eileen Sheehy, Manager of Bureau of Materials, [eileen.sheehy@dot.state.nj.us](mailto:eileen.sheehy@dot.state.nj.us)).
- New York recommends a shim or sand mix, or a 4.75 mm mix be laid down, followed by a tack coat (Zoeb Zavery, Materials Bureau, [zzavery@dot.state.ny.us](mailto:zzavery@dot.state.ny.us)).
- North Carolina reports no problems with overlay of ground-in rumble strips (Cecil Jones, [cljones@dot.state.nc.us](mailto:cljones@dot.state.nc.us)).
- Utah fills and levels strips that are an inch or more deep; this can entail use of HMA, or be as simple as filling with aggregate and spraying asphalt. For strips of less than one inch in depth, paving over can work if using four inches or more of new surface (Howard Anderson, Engineer for Pavements, [handerson@utah.gov](mailto:handerson@utah.gov)).

**Study Documents.** NHDOT provided a description of the four field site preparations for overlay (see **Field Preparation Description**, p. 4), as well as site inspections in 2005 and 2006 (see **July 2005 Site Inspection**, p. 5-6) and **April 2006 Site Inspection**, p. 7). Highlights include:

- Installations included one tack and overlay section; one tack, shim and overlay section; one mill, inlay and overlay section; and one mill and overlay section. Sites were completed by July 1, 2005.
- On July 21, 2005, only the tack and overlay section showed reflection cracking.
- On April 27, 2006, the tack, shim and overlay section showed depressions at the strip locations, the tack and overlay section showed significant reflection cracking; the mill, inlay and overlay showed no reflection or rutting; the mill and overlay section showed no reflection.

For information on current study and early findings, contact Denis Boisvert, 603.271.3151 or [dboisvert@dot.state.nh.us](mailto:dboisvert@dot.state.nh.us). For study abstract, <http://rip.trb.org/browse/dproject.asp?n=10267>. The photo and story below are from NHDOT's Research Highlights, Summer 2005.



### **Preparation of Rumble Strips Before Overlayment**

Since the use of continuous shoulder rumble strips is relatively new (mid to late 1990s), rehabilitation of the pavements where they have been installed is just beginning. NH performed its first thin (1-inch) overlay of rumble strips during the 2003 construction season. The rumbles immediately reflected through the new pavement. Inquiries to other state DOTs indicated a range of opinions on preparation techniques, from grinding the strip and shimming before paving, to doing nothing provided the overlay is more than 4 inches. The objective of this project is to develop a specification or guideline defining materials, sequences and/or options to perform this operation successfully and economically. Four preparation scenarios were selected and incorporated into a paving project on I-89 in Enfield. Test sections five hundred feet in length were installed in July 2005. Monitoring of the overlay will extend over at least one winter before new rumbles are milled in the same location.

## **Massachusetts**

In a report on rumble strip construction, the FHWA reports that Massachusetts paved over rumble strips in work zones for traffic diversion onto shoulders. The department milled a trench through rumble strips, filled them with asphalt, and paved over the shoulders. See Pavement Overlay, on the 8<sup>th</sup> page of [http://safety.fhwa.dot.gov/roadway\\_dept/docs/continuousrumble.pdf](http://safety.fhwa.dot.gov/roadway_dept/docs/continuousrumble.pdf).

**Preparation of Rumble Strips Prior to Overlayment –  
Research Project No. 13733V**  
(Document courtesy of Denis Boisvert, NHDOT, [dboisvert@dot.state.nh.us](mailto:dboisvert@dot.state.nh.us))

Research Documentation: Lebanon, NH Night Paving – 6/30/05 - 07/1/05

Russell Lemire, Research Intern

\*Paving performed by Pike Industries, Inc.

- Notes:
- Four test sections labeled A, B, C and D.
  - Each section 500 ft. long.
  - Located on I-89 Northbound, beginning near mile marker 55, north of Exit 16.
  - Test sections on both sides of road, travel lane/right shoulder done first.
  - RS2 (rapid set) grade tack coat used throughout paving project.

Test Section A: Travel lane/right shoulder

- Were supposed to tack and shim just rumble strip, instead tacked and shimmed entire 10 ft. width of shoulder section.
- Used ½ in. shim coat with 1 ½ in. overlay.
- 10 ton roller used on shim, both 10 ton and 30 ton rollers used on overlay.

Test Section B: Travel lane/right shoulder

- No special treatment for rumble strip, just tack and 1 ½ in. overlay.
- After compress 1 ½ in. overlay with roller, ruts from rumble strips underneath already show up through pavement.
- Ruts exaggerated by nighttime and headlights, probably not as noticeable during daytime.

Test Section C: Travel lane/right shoulder

- Ground out 20 in. wide rumble strip first, ½ in. deep.
- Grinding for test sections C and D took roughly 20 min. to grind 1000 ft. of rumble strip.
- Grinder operator had previous experience grinding out rumble strips.
- Ground rumble strip with cold-planing trimmer (not mounted on Bobcat).
- Tack coat ground out rumble strip for sections C and D at same time.
- Used paver mounted on front of Bobcat following asphalt truck to fill rumble strip.
- 10-ton back roller used to compress rumble strip inlay.
- Compacted to same level as existing pavement.
- Tack coat over inlay and rest of area to be overlayed.
- Overlayed 1 ½ in.

Test Section D: Travel lane/right shoulder

- Ground out rumble strip ½ in. deep.
- Cold plane and tack all at once.
- 1 ½ in. overlay (2 in. within rumble area).

\*Observations: Sections A, C and D seemed to be about the same resulting product with A having the rumble strip show through very slightly, while C and D didn't show through at all. Section B clearly showing rumble strip through pavement, made more visible due to nighttime lighting.

Test Section A: High speed lane/left shoulder

- Shimmed ½ in. over rumble strip first.
- Due to pavers running late, grader shimmed ½ in. entire width of high-speed lane and left shoulder.
- Rest same as travel lane and right shoulder.

Test Section B: High speed lane/left shoulder

- Tack coat and overlayed entire width at once.
- Rest same as other side.

Test Sections C and D: High-speed lane/left shoulder

- Same as other side, except shimmed over inlay instead of overlay.
- Rest same as other side.

\*Left site before the final overlay and compaction took place.

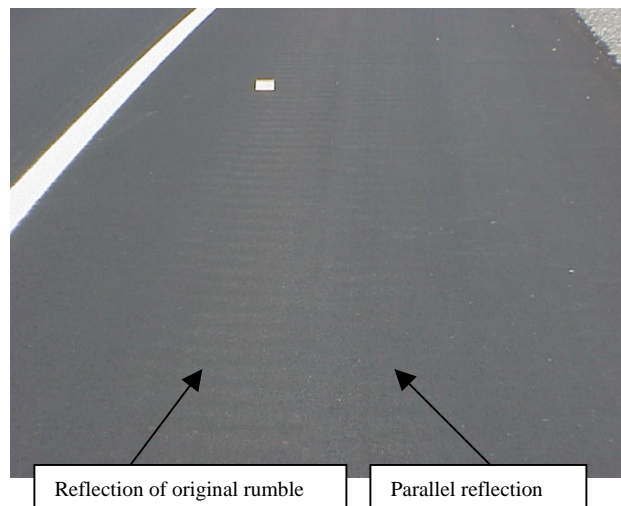
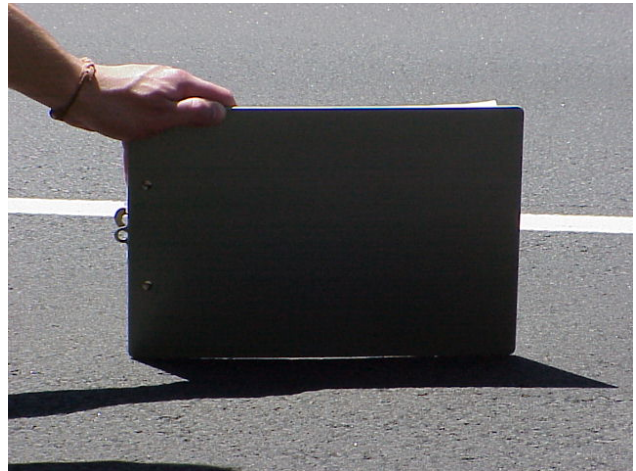
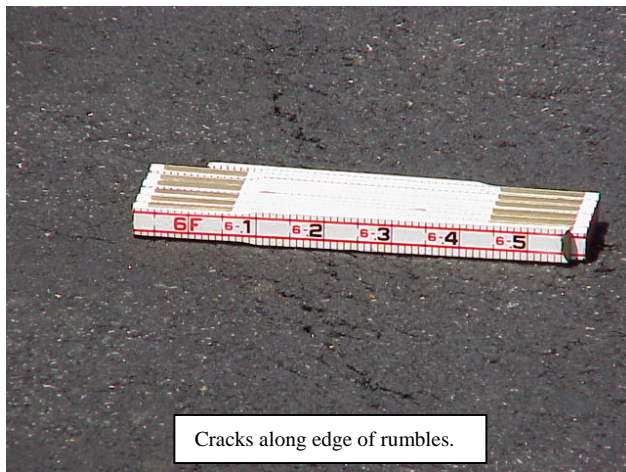
**Preparation of Rumble Strips Prior to Overlayment –  
Research Project No. 13733V  
Test Site Inspection – July 21, 2005**

Denis Boisvert, Asst. Research Engineer  
Russell Lemire, Research Intern

The purpose of the inspection was to obtain GPS coordinates for the section locations and to view the sections in daylight. Paving project Contract Administrator Warren Lathrop joined us to help locate the section boundaries. The test sections had been installed on the night of June 30/July 1, 2005.

Section A (shim and overlay) showed no indication of rumble strip reflection.

Section B (just overlay) showed occasional longitudinal cracks along the edge of the rumble strip, indicating movement of the mix by the roller through the affected rumble. The rumble strip had reflected through the overlay along the entire length of this section. Additionally, a parallel line of “reflected” rumbles was observed in this section. Mr. Lathrop interprets that the vibratory roller drum bounces due to the alternating mix thickness in the rumble strip, resulting in the indentation of the surface alongside of the original rumble strip.



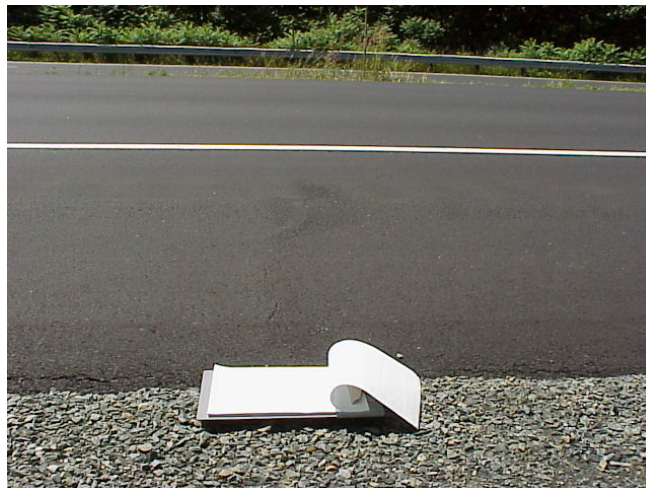


Section C (mill, inlay and overlay) showed no reflection of the milling, which would have displayed as a rut.

Section D (mill and overlay) also showed no sign of the former rumble strip.



General: Occasional lateral cracks were observed in the shoulder. Mr. Lathrop indicated that they were common in overlay projects, and is not associated with the rumble strip overlay. He explained that the crack seal material in the existing pavement is heated by the new overlay mix, expands, and cracks the overlay pavement before it cools, causing an immediate defect.

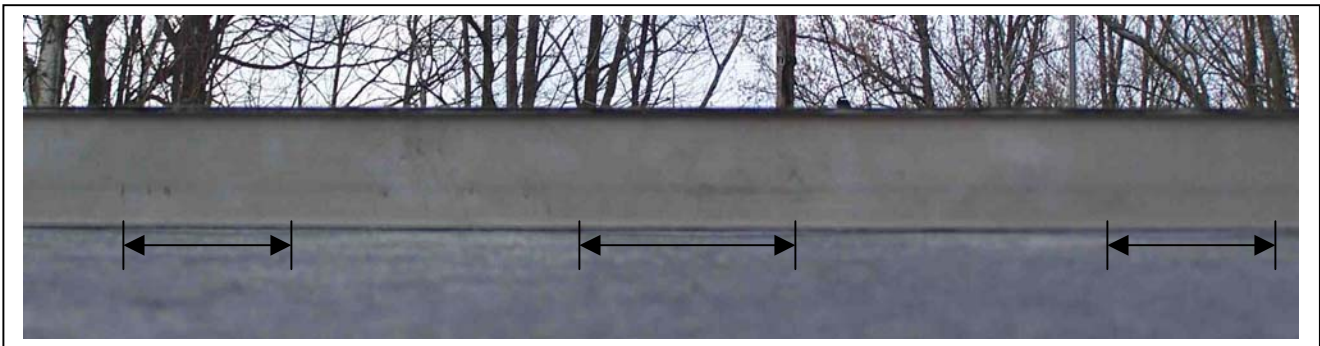




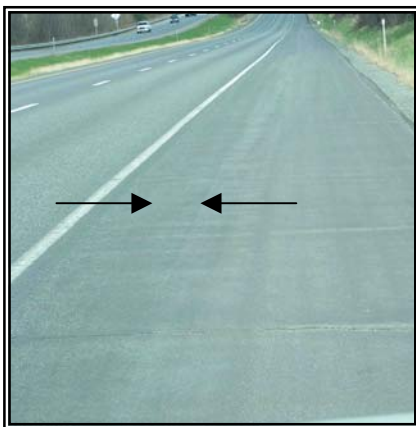
**Preparation of Rumble Strips Prior to Overlay**  
**Research Project No. 13733V**  
**Test Site Inspection – April 27, 2006**  
Denis Boisvert, Asst. Research Engineer

The purpose of the inspection was to make observations following the first winter of service. The test sections were installed on I-89 NB, beginning at mile marker 55.1, on the night of June 30/July 1, 2005. Four preparation scenarios were performed prior to placing a 1.5-inch bituminous overlay.

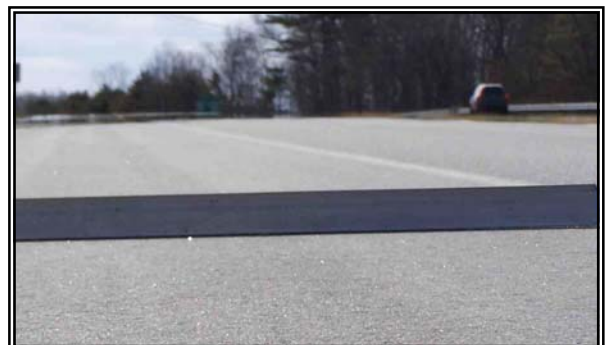
**Section A (shim and overlay)** showed no indication of rumble strip reflection last July. However, mild depressions are now visible (see below), due mainly to the abrasion of the snowplows on the rumble strip bars. The bars are also felt when driven upon.



**Section B (just overlay)** continues to show a pronounced rumble strip reflection, enhanced by the abrasion of the rumble bars, as shown at right. This preparation method requires the least effort. No additional deterioration was noted.



**Section C (mill, inlay and overlay)**, which includes the greatest number of steps to accomplish, still shows no reflection of the milled area, which would have displayed as a rut. Left, the outline of the former rumble strip is vaguely visible on the shoulder surface.



**Section D (mill and overlay)** also showed no sign of reflection in the area of the former rumble strip.